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# Ffso

## **THE SYMPATHETIC NERVOUS SYSTEM**

The **sympathetic** and the parasympathetic **nervous system** are parts of what is commonly called the autonomic **nervous system**. (Autonomic = can not be controlled by the mind). You can say that these systems work in balance with each other and directly or indirectly affect almost every structure in the body (e.g. heart frequency, heart capacity, lumbar function, kidneys, blood vessels, stomach and intestines)

The **sympathetic nervous system** has an active "pushing" function, the **parasympathetic** has mainly a relaxing function.

The **sympathetic nervous system** is located to the **sympathetic** chain, which connects to skin, blood vessels and organs in the body cavity. The **sympathetic** chain is located on both sides of the spine and consists of ganglia.

The autonomic **nervous system** is most important in two situations: emergency situations that cause stress and require us to "fight" or take "flight", and nonemergency situations that allow us to "rest" and "digest". The autonomic **nervous system** also acts in "normal" situations to maintain normal internal functions and works with the somatic **nervous system**. When the body reacts to signals about e.g. danger it is the **sympathetic** ganglia that makes

*The lungs and the bronchial tubes are widened to give us more oxygen.*

*The motility in the intestine is reduced - we shall not digest food - we must fight or run away!*

*Blood is sent to the brain while skin and internal organs get less.*

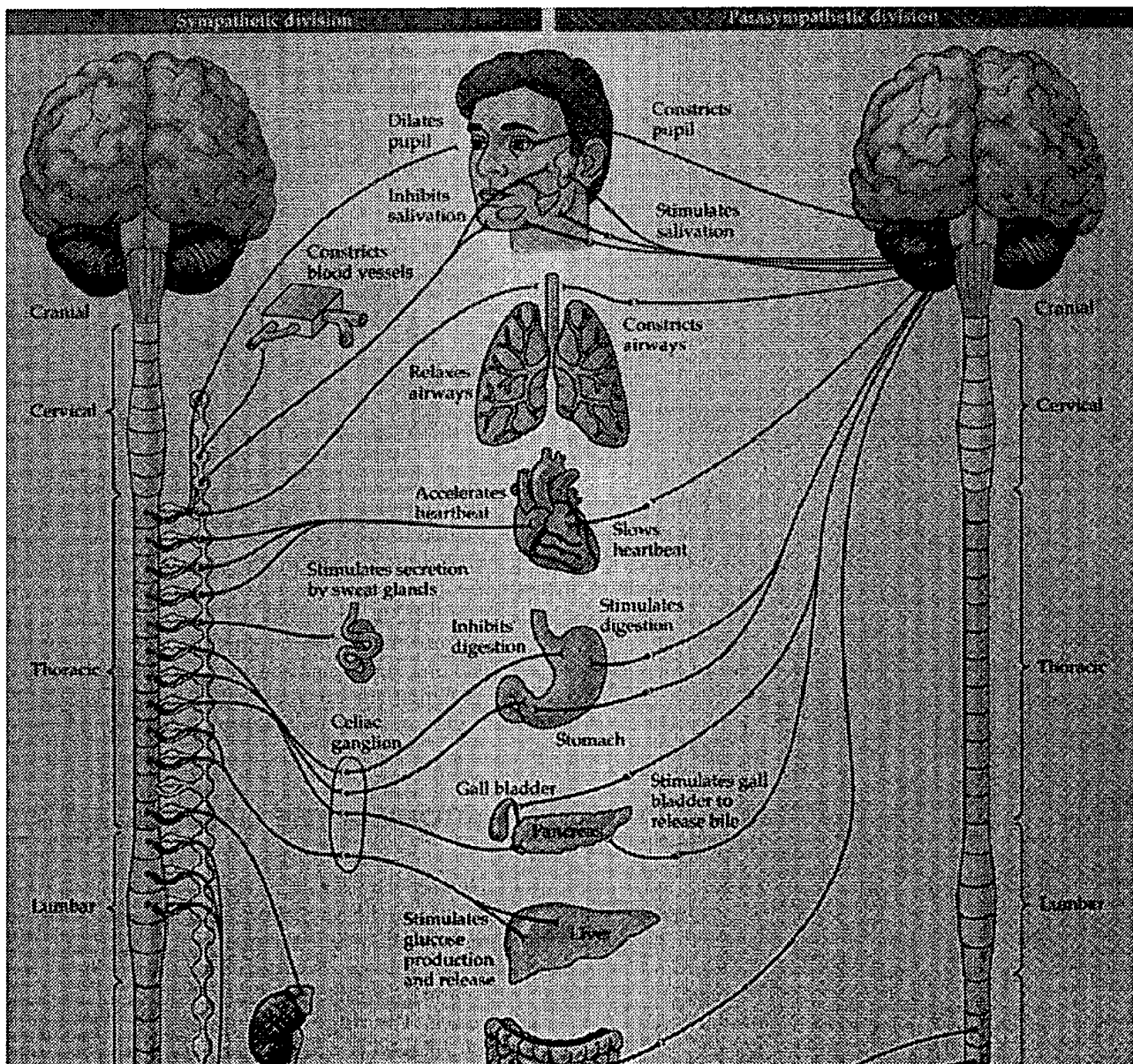
*Muscle tension is increased.*

*Heart rate and force is increased.*

Below you can find a summary of some of these effects:

Sympathetic	Structure	Parasympathetic
Rate increased	Heart	Rate decreased
Force increased	Heart	Force decreased
Bronchial muscle relaxed	Lungs	Bronchial muscle contracted
Pupil dilation	Eye	Pupil constriction
Motility reduced	Intestine	Digestion increased
Sphincter closed	Bladder	Sphincter relaxed
Decreased urin secretion	Kidneys	Increased urin secretion

(When you read about what a complicated **system** the **sympathetic** chain is, you wonder how anyone can allow surgeons to perform ETS..)





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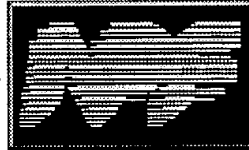
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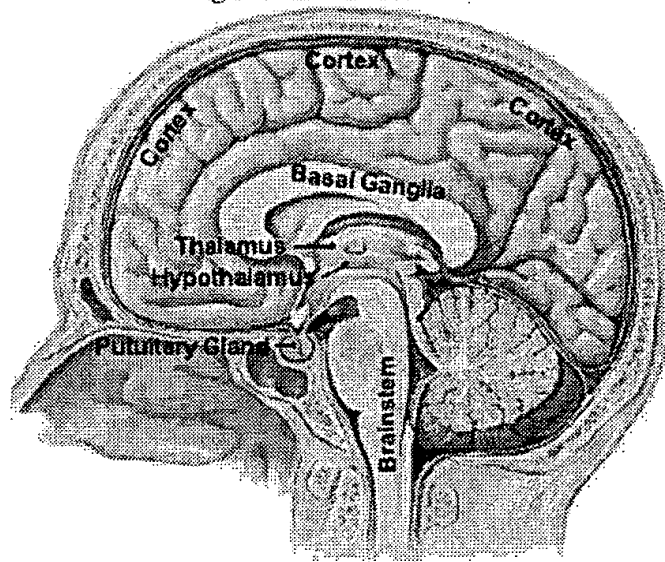
## The Sympathetic Nervous System

**The Sympathetic Nervous System** starts in the hypothalamus, deep inside the brain. The hypothalamus is below the thalamus and above the pituitary or master gland. The hypothalamus governs the pituitary gland that in turn governs:

- (1) the thyroid gland which governs metabolism
- (2) the adrenal glands which help govern blood pressure and fluid balance
- (3) the pancreas which governs blood sugar
- (4) the ovaries and testes

The thalamus is the brain's main relay center. And through the eyes, the ears, the nose, and from nerve endings in the skin, the thalamus receives information about the outside world.

Cerebrum - Brain In Situ  
Sagittal Section - Medial View



The thalamus receives information about the body's internal organs from:

- (1) Pressure sensors on the heart and large arteries
- (2) Stretch sensors on medium and small arteries and veins
- (3) Pressure sensors on the major airways
- (4) Sensors in the heart, small arteries and veins, liver, kidney, and pancreas that monitor oxygen levels, blood acidity (pH), sugar, and salt concentration
- (5) Stretch sensors on the walls of the stomach, intestines, rectum, and bladder

Information about the outside world and the internal organs after being "decoded" and analyzed, is sent to the hypothalamus. Here, groups of nerve cells, called primary **sympathetic** cells reanalyze the information and send it to secondary **sympathetic** cells in the brainstem and spinal cord. Groups of secondary **sympathetic** cells extend along the spinal cord from the neck to the lower back.

The secondary cells send information to third-order **sympathetic** cells located in chains that parallel the spinal cord. Flow of information from primary to secondary to third-order cells to their target organs, is aided by the chemicals nor-adrenalin and adrenalin. On blood vessels these chemicals interact with specialized receptors.

The **Sympathetic Nervous System** can activate all the body's organs, a few organs, or part of an organ. The "fine-tuning" is accomplished by activating:

- (1) A specific number, or sequence, or group of **sympathetic** cells
- (2) A specific number, or sequence, or type of receptors on an organ
- (3) Selective release of hormones from the pituitary, thyroid, adrenal, pancreas, ovaries or testes.

### The Para-**Sympathetic Nervous System**

The Para-**Sympathetic Nervous System** starts in the brainstem, below the hypothalamus. Primary para-**sympathetic** cells receive information from the outside world and the internal organs. But, compared to the **sympathetic** cells, the amount and quality of information is limited. Most of it after being analyzed is sent via the Vagus Nerve to secondary para-**sympathetic** cells located in chains near the organs they serve. Information is relayed from these cells to receptors on their target organs by the chemical acetyl-choline. The Vagus serves almost every organ except the rectum, bladder, uterus, and testis. These are served, via sacral nerves, by primary Para-**Sympathetic** cells in the lower spinal cord.

Understanding the **Autonomic Nervous System** is central to understanding anxiety and panic. W B Cannon wrote:

In an open **system** such as our bodies, a **system** subject to numberless disturbances, the very existence of a poised or steady state is in itself evidence that agencies are at hand keeping the balance, or ready to act in such a way as to keep the balance.

If the state remains steady, there is an automatic arrangement whereby any tendency toward change (as detected by internal sensors and relayed to the thalamus) is effectively met by increased action of the factor or factors which resist the change.

Despite colorful diagrams and fine words, the Autonomic **Nervous System**, is hard to understand. An analogy is offered.

Think of the **Sympathetic Nervous System** as the Federal Government.

(1) The Federal Government's central offices are in Washington. Similarly, the **Sympathetic System's** "central offices" are in the hypothalamus. ✓

The Federal Government has regional offices throughout the nation. Similarly, the **Sympathetic s System's** "regional offices," are on secondary cells throughout the spinal cord.

The Federal Government has local offices in cities, counties, and towns. Similarly, the **Sympathetic System's** "local offices" are on third-order cells near their target organs.

(2) The Federal Government receives feedback, from it's Washington, regional, local, and overseas offices, from the people and their Representatives. Similarly the **Sympathetic System** receives information from sensors on its target organs, secondary, and third-order cells, and the thalamus.

The Federal government has executive, legislative, and judicial functions. These effect people in discrete, overlapping, or, even contradictory ways.

Similarly the **Sympathetic System** alone or with help from one or multiple glands can effect an organ in different or contradictory ways. Thus, a person with a diseased heart will respond to anxiety differently from a person with a healthy heart.

Think of the Para-**Sympathetic Nervous System** as a state government.

(1) There are large populous states: California, Texas, New York, Florida. And less populous states: Rhode Island, Delaware, North and South Dakota. Each has it's own capital. Similarly, the Para-Sympathetic System's "large populous"(capital) offices are in the brainstem. And the "less populous" (capital) offices are in the lower spinal cord. Each state has local offices in it's cities, counties, and towns. There are no regional offices. Similarly, the Para-Sympathetic System's "local offices" are on secondary cells near their target organs. There are no third order cells.

(2) Each state government receives feedback from its local offices, from its people and their representatives. Similarly the Para-Sympathetic System receives feedback from sensors on it's target organs and their secondary cells and the thalamus.

Each state has executive, legislative, and judicial functions. These effect their people in discrete, overlapping, or, even contradictory ways. Similarly the Para-Sympathetic System can effect an organ in different or contradictory ways.

The Federal Government and the states also effect people in overlapping or even contradictory ways. Similarly the Sympathetic and Para-Sympathetic Systems can effect an organ, or multiple organs in different or contradictory ways.

Just as outside danger, disease, or pain can activate the Autonomic Nervous System, anxiety, fear, anger and panic can also activate the Autonomic Nervous System. As W B Cannon wrote:

When we consider the great role which fear and anger have played in the history of mankind as essential factors in self-preservation, there is little wonder that they are involved in processes of a most varied and extensive character, directed towards the mobilization of the bodily forces for physical struggle.

Just as we fear operations, or the consequences of moral error, or threatening financial disaster, the preparations for action occur as they have occurred in fear for myriads of generations in the past. The trouble now is the causes of fear are not so likely to be temporary as they were with our remote ancestors. We cannot run away, or go and kill, or be killed. The causes of fear, or uncertainty, persist and there is little to do. These persistent causes can result in establishing.....habits of reactions as real as any other...No pathologist could find a change to account for such trouble. This is what I call a functional (an anxiety-related) disorder.

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